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The Effects of Taxes on Earnings: Evidence from a Cohort Based Payroll
Tax Reform in Greece

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Abstract

This paper analyzes the response of earnings to payroll tax rates using a cohort-based reform in Greece. In late 1992, Greece passed a law increasing sharply the monthly earnings cap on payroll taxes for all individuals starting to work and pay social security taxes on or after January 1st, 1993. Tax rates, equal to 28% on employers and 16% on employees, remain the same for all workers. Using full population administrative Social Security data and a Regression Discontinuity Design, we compare current earnings of workers who entered before and after the 1993 tax regime change. This unusual reform allows us to estimate the long-term incidence and effects of marginal payroll tax rates on earnings. Standard theory predicts that, in the long run, new regime workers should bear the entire burden of the payroll tax increase (relative to old regime workers). In contrast, we find that employers compensate new regime workers for the extra employer payroll taxes but not for the extra employee payroll taxes. This non-standard incidence results are the same across firms of different sizes but we find that male employees get a larger compensation for the tax differential than female employees. We do not find any evidence of labor supply responses to the payroll marginal tax rate differential. We interpret our results, combined with a direct small survey of employers, as evidence of social norms in age related compensation practices.

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1 Introduction

In most OECD countries, social insurance programs such as public retirement benefits, public health insurance, disability and unemployment benefits, are financed by social security contributions on employment income. Such payroll taxes are quite large and impose significant marginal tax rates on earnings in countries with generous social insurance programs. Payroll taxes collect about 25% of total revenue on average in OECD countries (OECD, 2008), which is about the same as individual income taxes. Payroll taxes are much simpler than individual income taxes and share some key characteristics: (1) The base is in general restricted to employment earnings. (2) Tax rates are flat.¹ (3) The tax often applies only to earnings below a given cap.² (4) Payroll taxes are nominally shared by employers and employees. In a standard model, this nominal sharing does not matter for incidence and behavioral responses and, as a result, only the combined tax is relevant. In order to assess the efficiency and welfare consequences of such large payroll taxes, it is critical to estimate how labor supply and demand respond to them.

There is an extensive literature on the behavioral responses of reported income to the individual income tax (see Saez, Slemrod, and Giertz (2009) for a recent survey). Relative to the classic labor supply literature focusing on hours of work (see Blundell and MaCurdy (1999) for a survey), the new reported income literature recognizes that there are many other potential dimensions of responses such as unmeasured effort on the job, career choices, forms of compensation (non taxable fringe benefits, business vacations, etc.), and tax compliance. Those studies use individual income tax changes to estimate the elasticity of reported income with respect to marginal tax rates. There are two main issues with such elasticity estimates. First, non-tax related changes in the income distribution might be improperly attributed to changes in taxes when one compares a group affected by a tax change (such as high-income earners) to a comparison group not affected by a tax change (such as lower income earners). Second, tax changes can only credibly estimate short-term behavioral responses although long-term behavioral responses are of most interest for policy.

¹Tax rates sometimes vary by occupation but tend to be flat for a given employee in a given occupation.

²Some countries apply different caps to different social contributions, creating tax rate variation by earnings levels. For example, the United States has caps for Social Security retirement and disability contributions but no cap for elderly health insurance Medicare contributions. Some countries such as the United Kingdom also have floors exempting the first slice of earnings from payroll taxes.

In contrast, there is relatively little work on how payroll taxes affect labor supply. The literature on payroll taxes has focused primarily on incidence. In principle, as we expect labor demand to be substantially more elastic than labor supply, the incidence should be borne primarily by workers (Hamermesh, 1993). This has been the standard assumption in most analysis of the distributional effects of taxes (see e.g., Fullerton and Metcalf 2002 for a survey).³ Indeed, the most compelling macro-economic argument suggesting that the incidence is borne primarily by workers is the fact that the labor income share (which includes all payroll taxes) in the national product is fairly stable overtime and across countries (see e.g., OECD, 1990). A number of studies have used micro-data (either individual or at the industry level) and exploited payroll tax changes to analyze incidence effects and have found mixed results (Hamermesh 1979, Neubig 1981, Holmlund 1983, Gruber 1997, Lang 2003, Liang et al. 2004). Some studies have also tried to test whether the sharing of payroll taxes between employees and employers is irrelevant but have not reach a consensus on this question (Poterba et al. 1986, Dusek 2002, Mulligan, Gil, and Sala-i-Martin 2002). Importantly, those studies use standard payroll tax changes and hence suffer from the same two criticisms as the taxable income elasticity literature: identification is not fully compelling and the studies estimate short-run effects.

In this paper, we exploit an unusual payroll tax reform in Greece in order to estimate the long-run incidence and effects of taxes on earnings which overcomes identification difficulties that have plagued previous work. Greece has very high payroll tax rates on private sector workers with an employer tax rate of 28% and employee tax rate of 16% (on average), creating a combined marginal tax wedge of about 35% up to a monthly earnings cap above which no tax is charged. In late 1992, Greece introduced a reform in its payroll tax system in order to raise more revenue and restore the financial balance of its social insurance programs. The payroll tax change, however, applies only to new entrants, i.e., workers starting to work and pay payroll taxes on or after January 1st, 1993. Employees who started to work before 1993 continue to pay a combined employee and employer payroll tax up to a monthly cap equal to €2315 as of 2007. In contrast, employees who started to work on or after 1993, pay the same payroll tax rates but up to a much higher cap, equal to 2.3 times the old cap (€5280 as of

³This incidence assumption is also implicitly made in the reported income elasticity studies.

2007).⁴ As a result, today, about 10% of workers who entered shortly before 1993 are above the cap and face no payroll taxes at the margin. In contrast, only about 1% of workers who entered shortly after 1993 are above the new higher cap. Interestingly, this tax increase was not binding in the first years of the career as new entrants hardly ever had starting salaries above the old cap. However, as workers gain experience over the years, more and more reach the old cap level of earnings. Thus, the reform has effectively created two groups of workers who currently co-exist in the same labor market but face sharply different tax rates when they reach 2315 euros of monthly earnings (as of 2007).

Comparing pre-reform entrants to post-reform entrants using a regression discontinuity design (RDD) based on exact date of entry offers a unique opportunity to (a) evaluate the long-run incidence of employee and employer payroll taxes on earnings, (b) estimate the long-term impact of marginal tax rates on earnings. For this study, we have obtained access to administrative data from IKA, the social insurance agency in Greece, which manages payroll taxes and benefits for most private sector employees. The data include all individual workers in Greece who first entered the IKA system in any of the 10 years from 1988 to 1997. The data include the year of birth, gender, nationality, the exact day of entry in IKA (i.e., the first day with covered IKA earnings), and detailed job level and earnings variables for each of the months of March 2004, March 2005, March 2006, and March 2007. In each of those March datasets, and for each job, we have the number of days of work, occupation, monthly earnings broken down into various types: regular earnings, overtime earnings, bonuses, and other forms of earnings. Finally, the data include several employer level variables: industrial sector, geographical location, total number of employees in the firm. The longitudinal structure of the database allow us to link earnings and employers of each individual across time periods March 2004, March 2005, March 2006, and March 2007.

Four main results are presented in our analysis. First, we obtain non-standard incidence results. In principle, individuals entering shortly before 1993 and shortly after 1993 should be identical to employers and hence should receive the same gross earnings—as they are equally productive. However, we find that employers are willing to compensate new regime employees for their higher *employer* payroll taxes but not for their higher *employee* payroll taxes. As a

⁴Post-reform entrants had no cap at all on their payroll taxes from 1993 to 2003. In 2004, a cap equal to 2.3 the old cap was introduced.

result, new regime employees have (a) higher gross earnings (when including all payroll taxes) than old regime employees, (b) same earnings (the official measure of earnings which does not include employer payroll taxes but before deducting employee payroll taxes), (c) lower net earnings (when deducting all payroll taxes). Those results are true for total earnings (base pay + overtime + bonuses) but also for regular earnings (base pay).

Second, we find that incidence varies across groups. New regime male workers get a significantly higher compensation for the tax differential than new regime female workers. There is no heterogeneity across firm's size, however: incidence is identical across firms of different size. There is suggestive evidence that turnover is higher among new regime workers but only in large firms.

Third, we find no evidence of the payroll marginal tax rate differential on labor supply. Even if new regime workers bear only the employee portion of extra payroll taxes, this still reduces significantly (by 16% on average) net earnings at the margin relative to old regime workers. However, we find no evidence that new regime workers work fewer days, or report less overtime earnings.

Fourth, a survey of a few employers suggests that indeed employers do not try to reduce the earnings of new entrants in spite of the higher payroll taxes. In contrast to our prior views, employers say that concerns about treating similar employees (old regime vs. new regime) differently in terms of earnings is not the primary reason for those results. Almost all employers report that young workers tend to be the most productive but are also those paid the least because of norms of pay seniority. As a result, in spite of higher taxes, those young workers remain profitable hires to employers. We speculate that norms of seniority pay increases force firms to increase the slope of the wage profile relative to marginal productivity profile. Those norms seem to be based on posted earnings (as opposed to labor costs or net earnings). Firms may not be able to deviate from those norms because doing so might negatively affect morale among employees or public relations and hence not be profitable in the long-run. We discuss briefly how age based taxation, the Greek reform being one such example, might help reduce the norm based wedge between marginal productivity and labor costs profiles.

Our paper is organized as follows. Section 2 presents the institutional details of the Greek payroll tax and social insurance system, as well as the administrative data we use for the

analysis. Section 3 presents our empirical results. Section 4 (in progress) presents results from an employer survey, proposes a simple model accounting for the facts, and discusses policy implications. Finally Section 5 offers a brief conclusion.

2 Institutional Settings, Data, and Conceptual Framework

2.1 The Greek Payroll Tax System and the 1992 Reform

Social benefits in Greece accounted in 2004 for 26.0% of GDP (compared to an average of 27.3% in the 25 countries who were European Union members in that year). As elsewhere in Europe, social benefits are mainly financed through payroll taxes, also called social contributions.

Social insurance in Greece is fragmented along occupational lines. IKA, the social insurance scheme for private sector employees, covers almost 2.0 million contributors, or 45% of all active workers. The rest are divided among OAEE, the own-account workers' scheme for the self-employed with over 800,000 contributors, the farmers' scheme with 700,000 contributors, the civil servants' scheme with 450,000 contributors, as well as a number of special schemes covering specific professions such as doctor, lawyers, or engineers. This paper focuses exclusively on IKA workers.⁵

Social contributions payroll taxes for workers insured with IKA are set as proportion of monthly earnings as shown in Table 1 and are shared by employees and employers. Total contributions are quite high. Under the most common case (coverage code 101), the total employer rate is 28.06% of earnings and the total employee rate is 16% of earnings.⁶ Employer contributions are calculated on top of earnings, while employee contributions as deductions from earnings. The same contribution rates apply to all earnings irrespective of type of earnings (e.g. regular pay, overtime, bonus, etc.) or type of contract (e.g. full-time or part-time). Social insurance contributions are payable from the first euro earned and are always deducted at source by employers.

Importantly, contributions are based on monthly earnings and apply only up to a cap, above which no marginal payroll taxes applies. The cap for employees under the old regime (i.e.,

⁵There are significant differences in social insurance benefits across schemes, in terms of contribution rates and benefits. Typically, the special schemes enjoy much more favorable terms relative to IKA, OAEE, and the farmers' schemes.

⁶Workers in occupations classified as hazardous (about 800,000 IKA contributors are estimated to fall into that category) pay even higher rates.

those employees who have IKA covered earnings before January 1st, 1993), is set at €2,315.00 of monthly earnings. The cap for employees under the new regime (i.e., those employees who do not have IKA covered earnings before January 1st, 1993), the cap is set at €5,279.57. Both caps increase slightly each year, and by the same proportion, to reflect nominal increases in pay. The annual increases have been exactly 4% from 2004 to 2007 (the period we study). There is no formal indexation and increases are legislated each year. Note that new regime workers had no cap at all from 1993 to 2003. A cap set equal to 2.2806 times the old regime cap for was first introduced for new regime workers in 2004.

The contributions cap applies to all earnings irrespective of type, i.e., it is calculated by adding together earnings from regular pay, overtime, bonus, etc. earned in a given month. In the case of employees working for multiple employers, the cap for *employer* payroll taxes is based on monthly earnings within a given employer while the cap for *employee* payroll taxes is based on the sum of earnings across all employers. In practice, employers withhold both employee and employer taxes from paychecks up to the monthly cap. Multi-employer workers can apply to IKA for a refund of their employee contributions (but not the corresponding employer contributions) paid in excess of the cap.⁷ In the case of part-time employees, in the sense of workers employed for fewer days than the regular number of working days in the month, the cap is calculated on a pro-rata basis but only for old regime workers.⁸

• Interactions with the Income Tax

Income taxes are based on annual income net of all social security contributions and follow a progressive schedule, with marginal rates ranging from 15% to 40% in 2007. Income taxes are also withheld at source, final income taxes due are determined after the end of the financial year, when income returns are assessed taking into consideration tax relief and income from other sources. Importantly, the income tax schedule is the same for old and new regime workers. As a result, we do not incorporate income taxes in our analysis.

• The 1992 Pension Reform Act

In late 1992, Greece enacted the Pension Reform Act of 1992 (Law 2084/1992) in order to restore financial balance of the public retirement system. The reform affected contributions

⁷Payroll taxes in the United States follow a similar rule, although US payroll taxes are based on annual earnings, instead of monthly earnings.

⁸For new regime workers, there is no pro-rating.

(payroll taxes) and retirement benefits on a cohort basis. As mentioned above, new insurees, defined as individuals who did not have any covered earnings before January 1st, 1993 are treated differently from old insurees, defined as individuals who had some covered earnings before January 1st, 1993. On the contribution side, and as mentioned earlier, a higher upper earnings ceiling (or, until 2003, no upper ceiling at all) was put in place for new insurees, leading to higher payroll taxes for high earners. Social insurance contribution rates were increased for both new and old insurees (contribution rates are always the same for new and old insurees).

On the retirement benefit side, the law also changed the benefits computation for new insurees making the benefits formula for new insurees slightly less generous than for old insurees. In principle, this could create a lifetime wealth effect for new insurees (relative to old insurees) which could lead to higher labor supply for new insurees. For the relatively young workers we study in this paper, it is unlikely that this effect would be very large.⁹

However, and most important for our present analysis, retirement contributions can be considered almost as a pure tax for workers far from retirement both in the old and new regime. This is important because if benefits are linked to contributions in an actuarially fair way and if there are no credit constraints, then contributions would not be a tax. As a result, increased contributions would have no impact on the lifetime budget constraint and hence should not impact labor supply. For old regime workers, retirement benefits are based on the total number of insured days during the full career and the last five years of earnings. As a result, changes in the level of earnings at least five years before retirement do not affect retirement benefits. Therefore, for young and middle age old regime workers at least 5 years away from retirement, the retirement portion of social contributions is essentially a pure tax.¹⁰ For new regime workers, retirement benefits are based on the total number of insured days during the full career and the highest five years of earnings among the last ten years of earnings. As a result, changes in the level of earnings at least ten years before retirement do not affect retirement benefits. Therefore, for young and middle age new regime workers at least 10 years

⁹The discontinuity across cohorts in benefits could affect retirement age and individual savings. Hence, the sharp cohort based discontinuity created by the Greek reform could also be a useful “natural experiment” to analyze retirement and savings decisions to changes in social security benefits down the road.

¹⁰It is not exactly a pure tax, as supplying more labor when young could alter the full career path and lead to higher earnings when older. As we mentioned above, it seems very unlikely that young workers would be rational enough to take this effect into account when making their labor supply decisions.

away from retirement, the retirement portion of social contributions is also essentially a pure tax. Because our analysis focuses on relatively young workers—those who entered the IKA system between 1988 and 1997, as we shall see—retirement contributions are effectively a pure tax.

All the other contributions which finance sickness, unemployment, and other benefits, create virtually no linkage between the level contributions and benefits and can also be considered as pure taxes. Therefore, in this study, we will always consider all payroll taxes as pure taxes.

2.2 Administrative IKA Database

The data we use is extracted from the IKA administrative database. The data extract includes all individual workers in Greece who first entered the IKA system in any of the 10 calendar years from 1988 to 1997. Hence our data spans 10 cohorts, 5 before the reform and 5 after the reform. The core data include the year of birth, gender, nationality, the exact day of entry in IKA (i.e., the first day with covered IKA earnings), and insurance regime (old vs. new). The core data also include the sum of total insured days as of the end of 2005, as well as total 2005 annual earnings (broken down into regular and additional earnings). The data include scrambled individual identifiers (defined as a transform of the actual social security number) in order to link individuals across datasets.

We also have detailed job level and earnings variables for each of the months of March 2004, March 2005, March 2006, and March 2007. In each of those March datasets, and for each job, we have the number of days of work, occupation, monthly earnings. Individuals with more than one job during the month will have more than one job record. Individuals are identified by their (scrambled) individual identifiers. The monthly earnings are broken down into various types: regular earnings, overtime earnings, bonuses, and other forms of earnings. Earnings are reported in full with no cap. The data also include the exact employer and employee tax rates (which depend on the insurance code), as well as the exact amount of employer and employee payroll taxes paid out for the corresponding job. Finally, the data include several employer level variables: industrial sector, geographical location, total number of employees in the firm, as well as an employer (scrambled) identifier in order to link across databases. The longitudinal structure of the database allow us to link earnings and employers of each individual across the time periods March 2004, March 2005, March 2006, and March

2007.

For most of our analysis, we create an individual level data. For individuals with multiple employers, we define the main employer as the employer for which *regular* earnings are highest.

We limit our sample to individuals with Greek nationality (95% of workers in our sample are Greek nationals) because foreign citizens in our initial sample have very unbalanced dates of entry concentrated in the later period of our data as foreign workers are primarily immigrants from Eastern Europe.

Table 2 reports summary statistics, as of March 2007, for four groups of workers with positive IKA earnings in March 2007: (1) Those entering IKA from 1988 to 1992, i.e., old regime workers, (2) those entering IKA from 1993 to 1997, i.e., new regime workers, (3) those entering IKA from 1988 to 1992 with March 2007 earnings above €2315 (the old regime cap), (4) those entering IKA from 1993 to 1997 with March 2007 earnings above €2315 (the old regime cap). Several points are worth noting.

First, virtually all the old entrants are in the old regime as expected. About 95% of new entrants are in the new regime. The number is not 100% because individuals who had covered earnings in any insurance scheme (not necessarily IKA) before 1993 qualify for the old regime. As we shall see, this does not invalidate the analysis as entering IKA after 1992 is still a very strong predictor of regime status and hence marginal payroll tax rates.

Second, about 9% of all workers have earnings above the old cap (€2315), while only about 1% of all workers have earnings above the new cap (€5280). As shown in the table, the fraction of workers above the old cap is higher for old entrants because old entrants are older and have longer work experience, and hence higher earnings. The same is true for the fraction of workers above the new cap

Third, workers above the old cap are more likely to have bonuses, more likely to be male, more likely to work in larger companies, and less likely to have changed employers from March 2006 to March 2007. None of those of results are surprising.

Finally, the bottom rows of Table 2 show that new entrants face higher marginal payroll tax rates on average. The difference becomes especially large when looking at workers above the old cap. This is not surprising as old entrants above the old cap by definition should face no marginal payroll tax¹¹ while most new entrants above the old cap are still below the new

¹¹The rates are not exactly zero because of workers with multiple employers.

cap and hence face the full marginal payroll tax rates. As shown in the table, the difference in the total combined marginal tax rate between old and new entrants above the old cap is almost 25 percentage points.

2.3 Conceptual Framework

We will use three definitions of monthly earnings. First, gross earnings z are defined as earnings inclusive of employee and employer payroll taxes. Gross earnings can be interpreted as the total labor cost that employers pay for a given individual.¹² Second, earnings w are defined as gross earnings net of employer payroll taxes. In Greece, as in most other countries, payroll taxes are based on monthly earnings w . Earnings include not only the regular wages and salaries but also overtime pay, bonuses, as well as pay in arrears. It is therefore a broad definition of cash employment income which is used as the reference for computing payroll taxes and is also the standard reference for employer-employee compensation negotiations and decisions. Third, net earnings c are defined as earnings net of employee payroll taxes. This is the amount of disposable income (before individual income taxes however) that the worker actually receives.¹³

We denote by τ_R and τ_E the employer and employee (respectively) marginal payroll tax rates. As described above, those marginal tax rates apply up to a threshold of earnings \bar{w} , which we call the cap. We denote by \bar{w}_O the cap in the old regime (for pre-1993 entrants) and by \bar{w}_N the cap in the new regime (for those entering after January 1st, 1993). As of 2007, we have $\bar{w}_O = 2,315$ and $\bar{w}_N = 2.28 \cdot \bar{w}_O = 5,280$.

As $c = (1 - \tau_E)w = [(1 - \tau_E)/(1 + \tau_R)]z = [1 - (\tau_R + \tau_E)/(1 + \tau_R)]z$, the combination of employer and employee payroll taxes are equivalent to a combined tax rate $\tau = (\tau_R + \tau_E)/(1 + \tau_R)$ up to a threshold of gross earnings $\bar{z} = \bar{w} \cdot (1 + \tau_E)$. In Greece, the most common rates are $\tau_R = 28\%$ and $\tau_E = 16\%$ for a combined rate $\tau = 34.4\%$.¹⁴ We denote by \bar{z}_O and \bar{z}_N the old and new cap in terms of gross earnings. Similarly, we denote by \bar{c}_O and \bar{c}_N the old and

¹²The total exact labor cost might be slightly higher if employers offer additional fringe benefits. However, because the social security system is generous, such fringe benefits are rare in Greece.

¹³As mentioned above, individual income taxes are withheld at source as well so that take-home pay is $c' = c - T(c)$ where $T(\cdot)$ represents the withholding schedule for the income tax. Because the individual income tax applies uniformly across cohorts with no differentiation between old and new entrants, we do not need to incorporate the individual income tax in our analysis.

¹⁴There is variation in rates based on industry and occupation, primarily due to differences across hazardous vs. non hazardous occupations.

new cap in terms of gross earnings.

- **Fixed labor supply**

We start with a model with no labor supply responses where individuals differ by skill n . Under perfect competition and assuming a general production function which is a function of the each (fixed) supply of skill, gross earnings for a given skill should be equal to the marginal productivity of that skill. The distribution of marginal products across workers comes from the combination of the general production function and the fixed supply of each skill and is therefore independent of the payroll tax system.

Workers who entered shortly before Jan 1st, 1993 versus shortly after Jan 1st, 1993 should be very close substitutes in the labor market as they should have very similar characteristics in terms of age, gender, education, and work experience. Therefore, in a frictionless labor market, an employer maximizing profits should not be willing to pay more for a new regime worker than for an old regime worker with identical characteristics and hence identical marginal productivity. We will test this critical hypothesis extensively in the empirical analysis and show that it holds. This implies that the tax differential between new regime and old regime workers should be borne entirely by workers: gross earnings should be the same for both types of workers. This implies that earnings should be lower for new regime workers by the amount of the extra employer payroll taxes. Similarly, net earnings for new regime workers should be lower by the amount of extra employer plus employee payroll taxes.

- **Variable labor supply**

The simplest extension of our initial model is to assume that labor supply responds to marginal incentives. This model can be formally obtained by assuming that the individual with skill n maximize a utility function $u^n(c, z)$ where $c = z - T(z)$ is disposable income, z is gross earnings, and $T(z)$ is total employer plus employee payroll taxes. The utility function u^n is increasing in c and decreasing in z (as labor supply is costly). As depicted on Figure 1, a cap on payroll taxes effectively introduces a (concave) kink in the budget constraint set of the individual.

Figure 1 plots the budget constraints under the new and old regimes in the standard (z, c) diagram. The standard labor supply model makes three predictions about the effect of the

reform on labor supply depending on gross earnings levels. (1) Those with gross earnings below \bar{z}_O are not affected by the regime change. (2) Those with gross earnings between \bar{z}_O and \bar{z}_N experience an increase in marginal payroll tax rates from 0 to τ so that their net-of-tax rate decreases from one to $1 - \tau$. This will create primarily a substitution effect which will reduce gross earnings. There is pure substitution effect at $z = \bar{z}_O$ and the income effect grows with z . (3) Those with gross earnings above \bar{z}_N experience a pure income effect with no change in net-of-tax rates. This income effect should lead to an increase in earnings, under the standard assumption that leisure is a normal good. Our data on 1988-1997 entrants shows that the bottom 90% earners are below \bar{z}_O and hence not affected by the reform. Only a very small fraction of workers (the top percentile) are above the new cap \bar{z}_N .

Therefore, controlling for date of entry, the distribution of gross earnings (labor costs) for post-reform entrants should be identical to the distribution of gross earnings for pre-reform entrants below the old cap, i.e., in the bottom 90% or so of the distribution. Between the old and new cap, i.e., in the top 10% but excluding the top percentile, labor supply responses should reduce gross earnings of post-reform entrants (relative to pre-reform entrants). Above the new cap, i.e. in the top percentile, labor supply responses should increase gross earnings of post reform entrants. Therefore, empirically, we will examine how the distribution of gross earnings, earnings, and net earnings vary by date of entry.

Note finally that the reform might also generate responses along the extensive margin. The increase in taxes for new entrants after 1993 might induce some workers to pursue alternative careers outside the IKA covered sector such as becoming self-employed or even migrating for a foreign country.

3 Empirical Analysis

3.1 Estimation Design

As the 1992 reform is based on date of entry in the insurance system, our empirical analysis will be based on comparing current labor market outcomes in the IKA system based on date of entry into the IKA system. The reform creates a sharp discontinuity by date of entry with January 1st, 1993 being the dividing line. Because earnings and other characteristics vary by date of entry, for example older entrants have higher earnings because of higher experience

and seniority as shown in Table 2, we cannot directly compare old and new entrants. However, absent the 1992 reform, we should expect differences between old and new entrants to shrink as we compare entrants just before and just after the cut-off line. This feature leads naturally to a Regression Discontinuity Design (RDD). We will identify effects by running regressions of the form:

$$Y_i = \alpha_0 + \beta_0 \cdot 1(t_i \geq 0) + \sum_{k=1}^K \alpha_k \cdot t_i^k + \sum_{k=1}^K \beta_k \cdot t_i^k \cdot 1(t_i \geq 0) + X_i \gamma + \varepsilon_i, \quad (1)$$

where t_i is the entry date of individual i normalized so that $t = 0$ at the cut-off line of January 1st, 1993 and X_i denotes a vector of additional control variables. The coefficient of interest capturing the effect of the discontinuity at $t = 0$ is β_0 (as the polynomials in t^k are zero at $t = 0$). Polynomials in t are included in order to control in a flexible way for the effect of date of entry t on outcome Y . There are two main ways to assess robustness of the RDD results to the specification: (1) restrict the sample to a narrower window around the cut-off date, which we will do by limiting the sample to 1991-1994 entrants (instead of 1988-1997 entrants), (2) include higher order polynomials (the parameter K) in the regression specification.

A simple way to illustrate the RDD is to plot average outcome Y by date of entry month bins and draw the quadratic fit below and above the cut-off line. Because of strong seasonal effects in entry date (due to the annual periodicity of the job market), we shall see that graphs based on annual date of entry are often more useful than monthly graphs to uncover effects. The graphical evidence will then guide the formal regression analysis.

3.2 First Stage and Identification Checks

Panel A on Figure 2 plots the fraction of March 2007 workers in the new regime by month of entry in the IKA insurance scheme. Unsurprisingly, there is an enormous discontinuity as hardly any worker entering IKA before 1/1/1993 is in the new regime and about 95% of workers entering IKA on or after 1/1/1993 are in the new regime. As mentioned above, the number is not 100% because post reform IKA entrants may have made contributions to another insurance scheme before 1993, in which case they qualify for the old regime. Panel B in Figure 2 plots the fraction of workers (as of March 2007) above the earnings cap (€2315 for old regime workers and €5280 for new regime workers). The graph shows indeed a sharp discontinuity at the cut-off date showing that the fraction above the cap drops from about 8%

down to 2% exactly at the discontinuity, reflecting the fact that most post reform entrants are in the new regime with the much higher cap. The fraction above the cap decreases smoothly by date of entry both among the old and new entrants because average earnings increase with age and experience as we shall see. Figure 2 demonstrates that the cohort based reform does create a very strong first stage effect on the probability of facing payroll taxes at the margin.

As mentioned earlier, a key requirement for identification is that the workers entering just before and just after the cut-off dates are comparable. This identification requirement could be invalidated if some workers had strategically selected their date of entry in response to the reform. Therefore, Figure 3 plots the number of workers by month of entry. Panel A focuses on the sample of all IKA workers with positive earnings as of March 2007 while Panel B focuses on the narrower sample of all IKA workers with earnings above the old cap (€2315) in March 2007.

The graphs show large month to month variations in the number of entrants due in part to seasonality effects. Importantly, the quadratic fit curves show that there is no discontinuity in the number of entrants around the cut-off date. Specifically, we observe no spike in the number of entrants just before the cut-off date. This implies that individuals did not try to game the system by rushing into IKA covered jobs just after the law was passed in late 1992 and before January 1st, 1993 in order to benefit from the more advantageous old regime. There are three possible explanations for the absence of gaming effects. First, there was very little time between the time the law was enacted in late 1992 and January 1st, 1993. Second, formal IKA covered jobs cannot easily be found or created.¹⁵ Third, the difference between the two regimes might not have loomed large for young workers as they are very far from retirement to care about changes in retirement benefits and, at the very start of their career, their earnings are almost always below the old cap making the difference in caps irrelevant for a number of years. The absence of gaming is critical for our subsequent analysis as gaming could have created a discontinuity in the composition of workers just below and just above the cut-off, and hence could have invalidated the RDD estimation.

The fact that we do not observe a discontinuity in Panel B, among highly paid workers, suggests that highly educated workers with high pay expectancy did not respond to the reform

¹⁵In contrast to the United States, most part-time and low paid jobs for teenage workers in Greece are not in the covered sector and hence do not qualify workers for the old regime status.

along the *extensive* margin by choosing to move to other sectors of activity outside IKA such as the self-employed or even migrating to another country, a point to which we will come back later on.

Figure 4 provides further identification checks by plotting the fraction male (Panel A) and the average age (Panel B) by month of entry. The fraction male was slightly above 50% for the early entry years and falls to slightly below 50% in the late entry years. Unsurprisingly, the average age falls by date of entry. Most importantly however, in both cases, the graphs show that there is no discontinuity at the cut-off line supporting our hypothesis that entrants just before and just after the cut-off date are comparable.

Those first stage effects and the absence of effects along those other dimensions are formally estimated in a regression framework and presented in Table 3. The table displays the coefficients (with standard errors in parentheses) from regressing various outcomes (listed in the left-hand-side column) on a dummy for entering IKA on or after 1/1/1993. The sample includes all entrants with positive monthly earnings in March 2007.¹⁶ Each row focuses on a specific outcome. Each column corresponds to variations in the RDD specification. Column (1) estimates includes a linear entry date (normalized to 0 at 1/1/1993) and a linear entry date interacted with the dummy for entering IKA after 1/1/1993. Column (2) uses the same controls as column (1) but limits the sample to those entering IKA from 1991 to 1994. Column (3-5) use all 1988-1997 entrants but add successively Monthly dummies (col. 3), quadratic date trends (quadratic term and quadratic term interacted with the dummy for entering IKA after 1/1/1993), cubic date trends (cubic term and cubic term interacted with the dummy for entering IKA after 1/1/1993). Total MTR is the combined marginal payroll tax rate adding employee and employer payroll tax rates. The marginal tax rate is zero when the individual worker is above cap. Two points should be noted.

First, the first stage results in terms of (a) percent in new regime, (b) percent reaching the cap (of their respective regime), (c) average marginal tax rate (among all workers) all display a very significant discontinuity that is very robust for the various specifications such as restricting the sample to 1991-1994 or the number of polynomials date of entry controls included in the regression. Those results confirm the graphical results from Figure 2 showing that the

¹⁶Results are very similar in the other March 2004, March 2005, or March 2006 samples and omitted for sake of space.

Greek payroll tax reform did generate a very strong first stage effect. Second and in contrast, none of the identification checks variables displays robustly significant results. A variable may sometimes be significant in one specification but the result is not robust to alternative specifications. Therefore, those regression results also confirms our previous graphical analysis showing that the 1992 reform does not create discontinuities in the composition of the workforce around the reform cut-off date. Based on those results, we now turn to the second stage effects on earnings outcomes.

3.3 Effects on Earnings

3.3.1 Effects on Average Earnings above Old Cap

We now turn to the earnings results. Motivated by our theoretical framework, we should expect to find the strongest effects on the distribution of earnings between the old cap and new cap. Therefore, perhaps the most natural measure to look at is average earnings above the old cap but capping earnings at the new cap. In the case of earnings, we therefore consider the variable $\min(w, \bar{w}_N)$ where \bar{w}_N is the new cap. In the case of gross earnings, we consider the variable $\min(z, \bar{z}_N)$ where $\bar{z}_N = \bar{w}_N \cdot (1 + \tau_R)$ is the new cap in gross earnings. Similarly, in the case of net earnings, we consider the variable $\min(c, \bar{c}_N)$ where $\bar{c}_N = \bar{w}_N \cdot (1 - \tau_E)$. Average gross earnings (resp. earnings, net earnings) above the old cap but capping earnings at the new cap are therefore defined as $E(\min(z, \bar{z}_N | z \geq \bar{z}_O)$, (resp. $E(\min(w, \bar{w}_N | w \geq \bar{w}_O)$, $E(\min(c, \bar{c}_N | c \geq \bar{c}_O)$). Our theoretical prediction from the standard model is that, if there are no labor supply responses, there should be no discontinuity $E(\min(z, \bar{z}_N | z \geq \bar{z}_O)$ at the date of entry cut-off, and that $E(\min(w, \bar{w}_N | w \geq \bar{w}_O)$ and $E(\min(c, \bar{c}_N | c \geq \bar{c}_O)$ should fall at the date of entry cut-off because of the mechanical increase in payroll taxes. If there are labor supply responses, then $E(\min(z, \bar{z}_N | z \geq \bar{z}_O)$ should fall at the date of entry cut-off (and $E(\min(w, \bar{w}_N | w \geq \bar{w}_O)$ and $E(\min(c, \bar{c}_N | c \geq \bar{c}_O)$ should fall even more).

Figure 5, Panel A displays average monthly gross earnings (capped at the new cap as discussed above) for workers with earnings above the old cap by month of entry into IKA. In order to increase the precision of our estimates, we have pooled together earnings data from March 2004, March 2005, March 2006, and March 2007. We inflate earnings for earlier years by 4% per year so that caps align exactly across the 4 waves (as both the old and new cap were adjusted upward by 4% each year from 2004 to 2007 to account for nominal wage growth). The

cloud of dots and especially the quadratic fit curves show a very clear *upward* discontinuity around the cut-off line. In contrast to the theoretical prediction, gross earnings jump *up* for new regime employees. Suggestively, gross earnings of new entrants appear to decline faster (with date of entry) for post-reform entrants than for pre-reform entrants.

Panel B on Figure 5 shifts to plots by year of entry—instead of month of entry—in order to reduce the number of dots and the underlying noise in the time series. The annual plots visually confirm the findings of Panel A that gross earnings jump *up* around the cut-off entry date. Post-reform entrants receive higher gross earnings than pre-reform entrants. Note that by far the biggest jump in the annual series occurs from 1992 to 1993 as the series is fairly stable in all other years, providing compelling evidence that the change in tax regime had a positive impact on gross earnings among high earners affected by the tax reform.

Figure 6, Panel A, displays simultaneously average gross earnings (already displayed on Figure 5, Panel B), average earnings, and average net earnings (always capped at the new cap) for individuals with earnings above the old cap. Formally, each of those three statistics are defined as $E(\min(z, \bar{z}_N | z \geq \bar{z}_O)$, $E(\min(w, \bar{w}_N | w \geq \bar{w}_O)$, and $E(\min(c, \bar{c}_N | c \geq \bar{c}_O)$. As we saw earlier, gross earnings increase at the cut-off date. However, there is no visible discontinuity in earnings. Finally, net earnings display a clear drop at the cut-off date. For all three series, the graphical evidence appears pretty precise as series are stable and smooth, except at the cut-off date. Panel B offers a “placebo” test by considering average gross earnings, earnings, and net earnings for the sample of individuals with earnings above €1500 and capping gross earnings, earnings, and net earnings at the old caps $\bar{z}_O = (1 + \tau_E) \cdot \bar{w}_O$, $\bar{w}_O = 2315$, and \bar{c}_O respectively. This is a placebo because, in principle, there should be no discontinuity effects as individuals below the old cap are not affected by the 1992 reform. Indeed, the graph confirms that there is no visible discontinuity at the cut-off date as all three series are smooth and stable over the full period including around the cut-off date.

The graphical evidence displayed on Figures 5 and 6 offers striking evidence of the key point we will make in this paper. In sharp contrast to the standard model we developed above and which predicts that new regime entrants should bear the full (employee plus employer) payroll tax differential, we find that employers compensate new regime entrants for the extra *employer* payroll taxes so that gross earnings are higher for new entrants and earnings are

actually the same for new and old entrants. In contrast, employees seem to bear the full burden of the extra *employee* payroll taxes so that net earnings are lower for new entrants. All standard theoretical models predict that the division between employer and employee payroll taxes should not matter for the ultimate incidence of the payroll taxes between employees and employers. The unusual cohort based Greek reform offers clear evidence contradicting this clear-cut prediction of the standard model.

Table 4 presents the RDD estimates corresponding to the graphical evidence displayed on Figures 5 and 6 using the same five RDD specifications used in the earlier Table 3. Panel A focuses on total earnings (as in Figures 5 and 6) while Panel B focuses solely on regular earnings (i.e., base salary excluding overtime, bonuses, and other special payments). Panel C considers the “placebo” experiment (as in Figure 6, Panel B) using the sample of individuals with earnings above €1500 and capping gross earnings, earnings, and net earnings at the old caps $\bar{z}_O = (1 + \tau_E) \cdot \bar{w}_O$, $\bar{w}_O = 2315$, and \bar{c}_O respectively.

The table confirms the graphical results. First, in all specifications, we find a positive and significant effect for gross earnings. Gross earnings jump by about €170-190 at the discontinuity and the coefficients are precisely estimated with very large t-stats 10. Second, we find a small and almost always insignificant result for earnings. Third, we find a negative and significant effect for net earnings. Net earnings jump down by about €110-150 at the discontinuity, with large t-statistics. Fourth, as shown on Panel B, the results are pretty similar when considering only regular earnings (base salary) instead of full earnings. This shows that the non-standard result is primarily due to base salary determination rather than additional earnings (overtime, bonuses, etc.). Finally, the placebo regressions consistently deliver very small and almost always insignificant results. This successfully shows that there is no discontinuity in earnings policies (gross earnings, earnings, or net earnings) at the cut-off entry dates below the old cap. Those negative placebo results can be seen as an additional identification check suggesting that there is no composition effects among workers around the cut-off entry date. Taken together, Table 4 offers compelling confirmation of our earlier graphical results and show that, for new entrants, employers bear the incidence of the extra employer payroll tax but that employees bear the incidence of the extra employee payroll tax.

3.3.2 Effects on Fraction of Workers with High Earnings

Instead of considering average earnings statistics, we now consider an alternative statistic, namely the fraction of workers with gross earnings, earnings, or net earnings above given fixed thresholds z^* , w^* , c^* . From our theoretical framework, we expect this fraction to be continuous at the cut-off date if z^* is below the old cap. This fraction should be stable for gross earnings z , go down for w and c if z^* (resp. w^* , c^*) are between the old and new caps and there are no labor supply responses. With labor supply responses, this fraction should also go down for gross earnings z .

Figure 7, Panel A displays, by year of entry in IKA, the fraction of workers with Regular gross earnings, earnings, and net earnings above $\text{€}z^* = 3000 * (1 + \tau_R)$, $w^* = 3000$, and $c^* = 3000 * (1 - \tau_E)$ as of March 2007. The cut-off $\text{€}3000$ is chosen so as to fall in between the old and new caps. Regular earnings are defined as base salary (excluding overtime, bonuses, and other special payments). We choose regular earnings (instead of total earnings as in our previous graphs) because regular earnings produce smoother series and hence more precise results. Unsurprisingly, the fraction of high earners is declining with date of entry as older entrants have more experience and hence higher earnings as we documented in Table 2. The striking finding however is that this declining pattern does not happen for gross earnings around the cut-off date: the fraction with high gross earnings is actually slightly higher in 1993 than in 1992. For earnings, the series are smoothly declining with no visible discontinuity. For net earnings, the decline is actually more pronounced from 1992 to 1993. Those findings are fully consistent with our previous findings showing that gross earnings (resp. earnings, net earnings) are actually higher (resp. the same, lower) for new entrants than for old entrants around the cut-off.

Panel B offers a placebo test by displaying the fraction of workers with Regular gross earnings, earnings, and net earnings above $z^* = 2000 * (1 + \tau_R)$, $w^* = 2000$, and $c^* = 2000 * (1 - \tau_E)$ as of March 2007. The cut-off $\text{€}2000$ is chosen so as to fall below the old cap. In principle, there should be no effect because the regime change does not affect taxes below the old cap as we discussed earlier. In that case, the series indeed do not display any discontinuity in their downward trend by date of entry around the cut-off date, providing a successful placebo check.

Table 5 presents RDD estimates based on those alternative earnings outcomes. Panel A estimated are for total earnings while Panel B estimates are for regular earnings (as on Figure 7). Based on the extensive robustness analysis with respect to RDD specification presented in Table 3 and 4, in Table 5, we limit ourselves to 2 specifications corresponding to columns (1) and (2) in Table 4: all entrants with linear trend controls and 1991-1994 entrants only with linear trend controls. Columns (1) to (3) are estimated based on all entrants and columns (4) to (6) are estimated based on the sample of 1991-1994 entrants only. Columns (1) and (4) are for gross earnings, columns (2) and (5) for earnings, and columns (3) and (6) for net earnings. The table shows that other outcomes above the old cap, such as the fraction of individuals above 3000 Euros (or 5000 Euros) follows the same pattern as we obtained above: there is an upward discontinuity for gross earnings, no robust discontinuity for earnings, and a downward discontinuity for net earnings. As our graphical evidence showed, we find no effects in the placebo case where we consider the fraction of workers above 2000 Euros.

3.3.3 Effects on earnings across subgroups

In this subsection, we explore whether effects are heterogeneous across groups defined by gender or size of firm.

- **Effects by Gender**

Figure 8, Panel A, displays average regular gross earnings (capped at the new cap) for workers with earnings above the old cap by year of entry separately for male and female workers. The series show an asymmetry in the discontinuity at the cut-off date across genders: there is a large upward discontinuity for males while the upward discontinuity for female is much smaller. Those results suggest that employers do not provide as large a compensation for the extra payroll taxes for female workers than for male workers. Those gender effects are formally estimated in Table 6, Panel A. Table 6 is built exactly along the model of Table 5. It shows effects for gross earnings, earnings, and net earnings for two RDD specifications (the full 1988-1997 sample and the restricted 1991-1994 sample) across 6 columns. Panel A shows indeed that the RDD effect on gross earnings, earnings, and net earnings are higher for men than for women, and often significantly so. For women, the effect on gross earnings is only barely significant while, the negative effect on net earnings is very significantly negative. This

shows that women display results that are closer to the standard theory, and suggests that employers may more easily pass on women than on men the extra cost of payroll taxes for highly paid new regime workers.

• **Effects by Size of Firms**

It is conceivable that small firms have less formal compensation policies and hence more flexibility to adjust pay based on the specific situation of the employee, and in particular the tax regime of the employee. Figure 8, Panel B, displays average gross earnings (capped at the new cap) for workers with earnings above the old cap by year of entry separately for small vs. large firms. The series show no visible difference across firms' size.

This absence of firm effect is formally confirmed in Table 6, Panel B. The estimates are very close across small and large firms and indeed none of the differences between small and large firms are significant and most estimates are actually very small in absolute size as well. Those results imply that the inability of employers to pass on new regime highly paid workers the extra cost of payroll taxes is shared by large and small firms alike.

3.4 Other Effects

3.4.1 Labor Supply

3.4.2 Turnover

We would like to test whether new regime workers are more likely to switch jobs than old regime workers. That could happen as new regime workers might generate a smaller surplus for the employer due to the extra taxes. This is also likely to happen if the employer does not observe regime status at the time of hiring (something to explore when we talk to employers' organizations).

3.4.3 Pay Increases

We now turn to the analysis of year to year increases in monthly earnings using the longitudinal structure of the data.

Below the old cap \bar{y}_0 , employee and employer payroll taxes are proportional to earnings y (for both old and new regime workers). Hence, a given percentage increase in earnings y leads to the same percentage increase in employer and employee payroll taxes. Hence to provide a

raise of 1 Euro in earnings y , the employer has to pay $1 + \tau_R$ Euros and the employee receives a net earnings raise of $1 - \tau_E$ Euros.

4 Interpretation

There are several potential explanations for why we find such non standard incidence effects.

4.1 Evidence from a Survey of Employers

In order to test those potential explanations, we carried out a small informal survey of five managers involved in personnel decisions at firms of medium to large size, and one union manager specializing on social security issues. Those managers were talking and providing perspective on behalf of employers. Each of those six persons were asked a set of questions on knowledge of employers about the differential tax regime and tax status of prospective recruits. Then we asked whether tax status matters to employers when making recruitment decisions and salaries offers, when offering pay raises to existing employees, or for lay-off decisions. If told that regime status does not affect those personnel decisions, we asked managers why this is the case. The exact formulation of the questions is provided in annex I in appendix.

Four important findings emerge from this survey.

4.2 An Explanation: Social Norms Regarding Pay Seniority

5 Conclusion

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1. Effect of the 1992 Greek Reform on Earnings

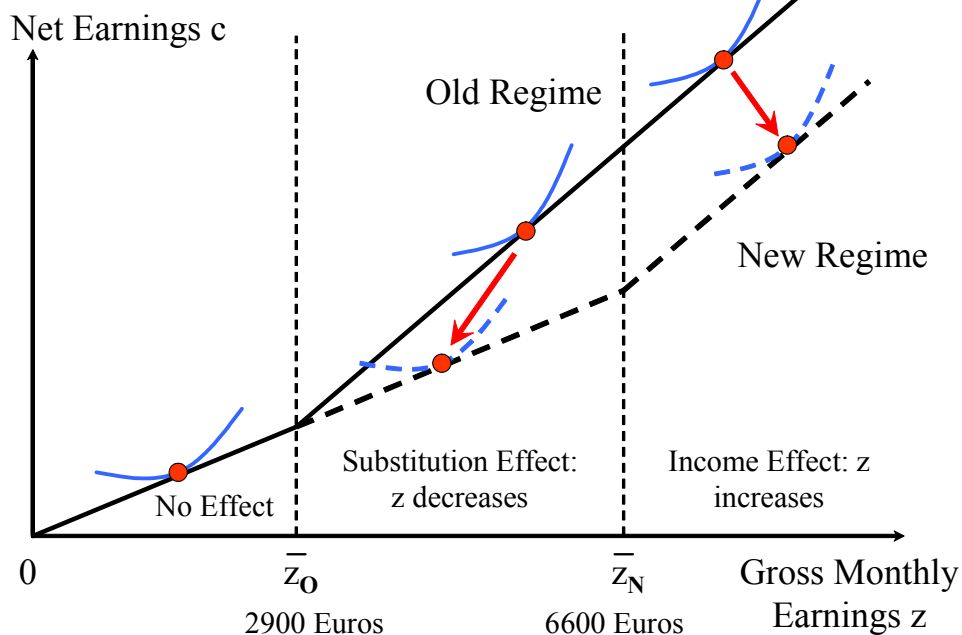


Figure 1. Conceptual Framework

The figure displays the effects of the 1992 pension reform in Greece on the monthly budget constraint of private sector employees (covered by the IKA social insurance system). The x-axis represents monthly gross earnings (including both employer and employee payroll taxes). The y-axis represents monthly net earnings (earnings net of both employer and employee payroll taxes). The solid line is the old regime budget (for those entering the IKA system before 1993) and the dashed line is the new regime budget (for those entering the IKA system on or after 1993). The reform increased the cap in earnings subject to payroll taxes from z_O to z_N for new regime workers, hence shifting outward the kink point in the budget set where the payroll marginal tax rate ends. In the standard model, workers with monthly earnings below z_O are unaffected by the reform. Workers with earnings between z_O and z_N experience a substitution effect which decreases gross earnings (and also an income effect but small relative to substitution effects). Workers with earnings above z_N experience only an income effect which increases gross earnings.

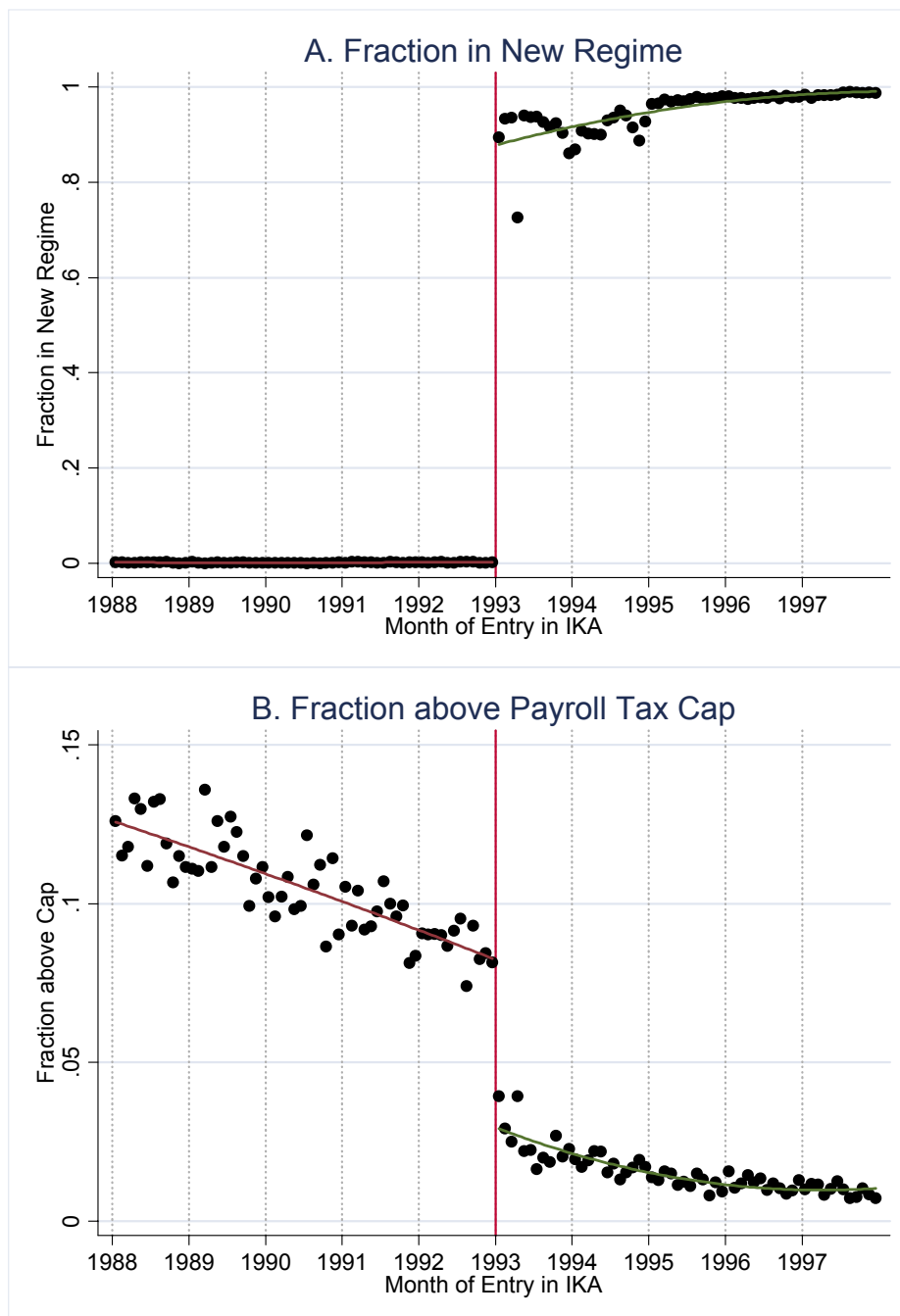


Figure 2. First Stage Effects: Fraction of Workers in New Regime and above Cap by month of entry

In both panels, the sample is all workers with positive earnings in the IKA social insurance scheme as of March 2007. Panel A displays the fraction of workers in the new regime by month of entry into the IKA system. Workers entering IKA before 1993 are all in the old regime. The vast majority of workers entering IKA on or after 1993 are in the new regime. Some post-1993 entrants are in old regime because workers who had covered earnings before 1993 in any other social insurance scheme (outside IKA) still qualify for the old regime. Panel B displays the fraction of workers with earnings above the payroll tax cap. There is a sharp drop at the 1/1/1993 cut-off dates as the cap for new regime workers is 2.3 times higher than for old regime workers. In both panels, the curve on each side of the discontinuity is the best quadratic fit.

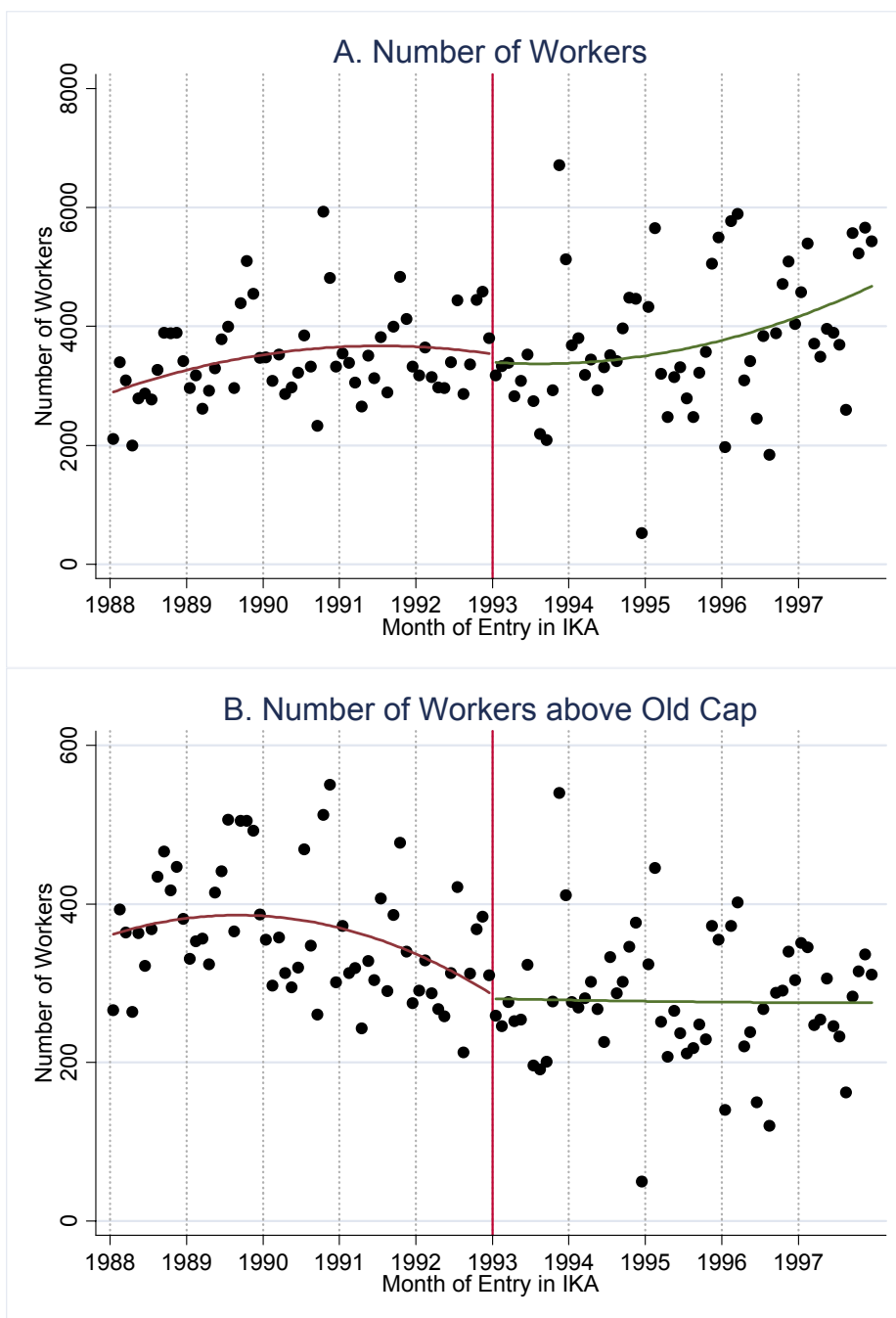


Figure 3. Identification Checks: Number of Entrants by Month of Entry

Panel A displays the number of workers by month of entry in the sample of workers with positive earnings as of March 2007. The graph displays no discontinuity at the cut-off date showing that workers did not game the system by entering IKA before 1993 when the reform was enacted in late 1992. Panel B displays the number of workers by month of entry in the sample of workers with earnings above the old cap (2315 Euros) in March 2007. The graph displays no discontinuity at the cut-off date showing that highly skilled workers did not game the system by entering IKA before 1993 and especially that highly skilled workers in the new regime did not respond to the higher tax along the extensive margin, by dropping out of IKA by migrating to jobs not covered by IKA.

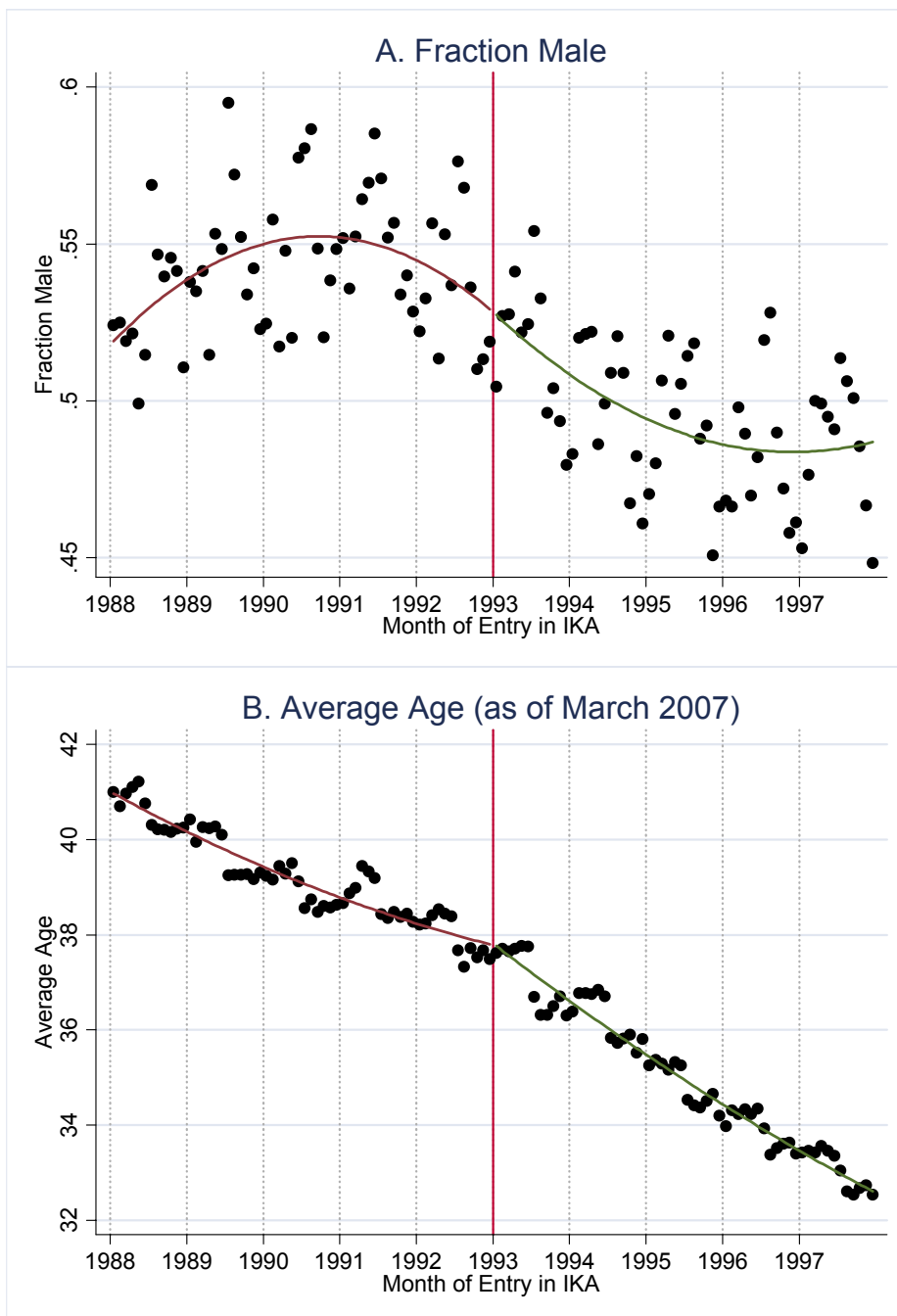


Figure 4. Further Identification Checks: Fraction Male and Average Age by Month of Entry

In both panels, the sample is all workers with positive earnings in the IKA social insurance scheme as of March 2007. Panel A displays the fraction of male workers by month of entry in IKA. Panel B displays the age of workers (as of March 2007) by month of entry in IKA. In both panels, the curve on each side of the discontinuity is the best quadratic fit. Both graphs display no discontinuity at the cut-off date showing that there is no systematic difference in observable variables between entrants just above and just below the cut-off, a requirement for the Regression Discontinuity Design to be valid.

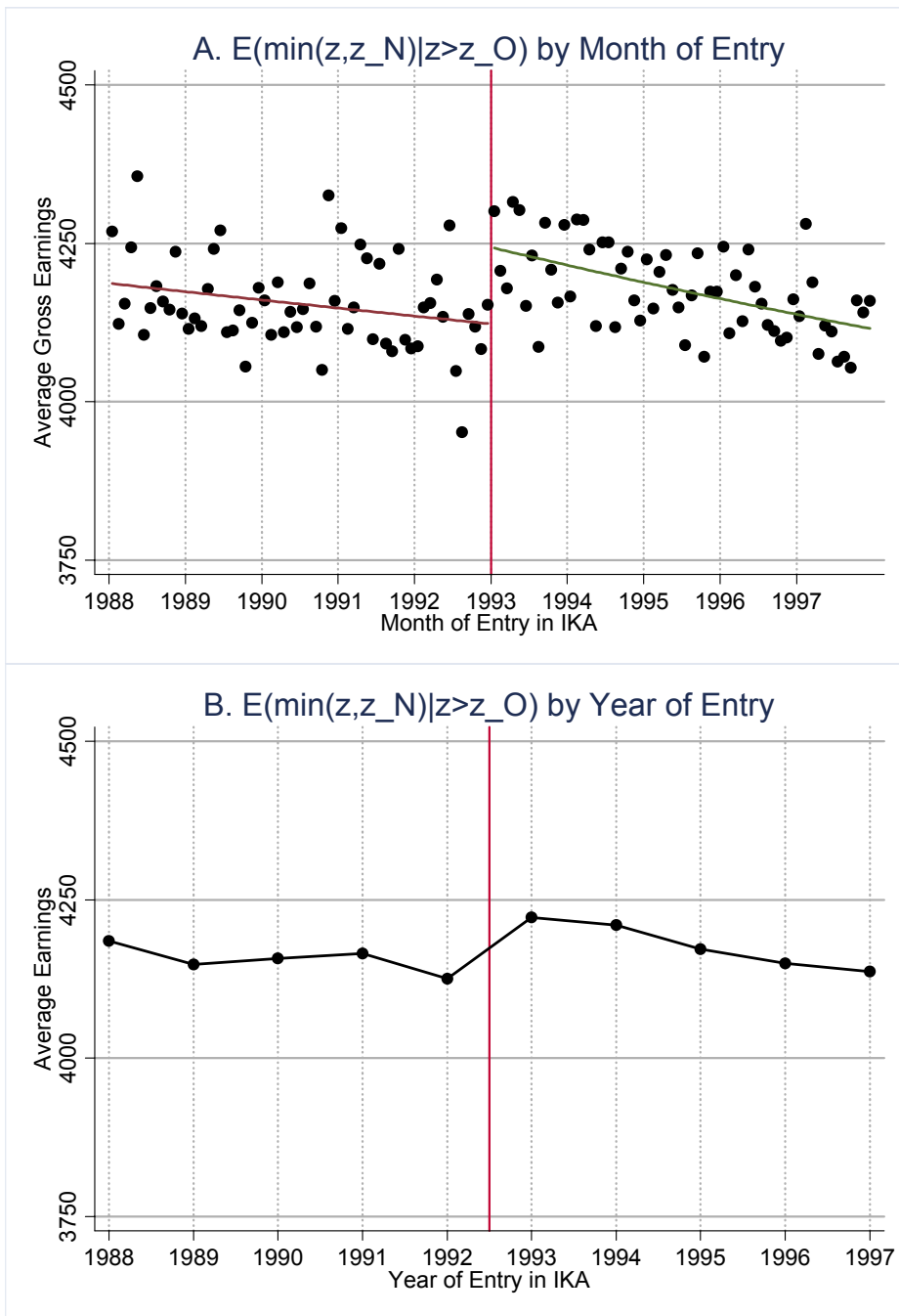


Figure 5. Effects on Gross Earnings above Old Cap

Panel A displays, by month of entry in IKA, the average gross earnings z , capped at the new cap z_N , for all workers with gross earnings above the old cap z_O as of March 2007. Formally, the statistic is defined as $E(\min(z, z_N) | z > z_O)$. The curve on each side of the discontinuity is the best quadratic fit. Panel B repeats the same series but aggregated by year of entry. Both panels show a clear upward discontinuity around the cut-off date, which goes opposite to the prediction from the standard model presented on Figure 1.

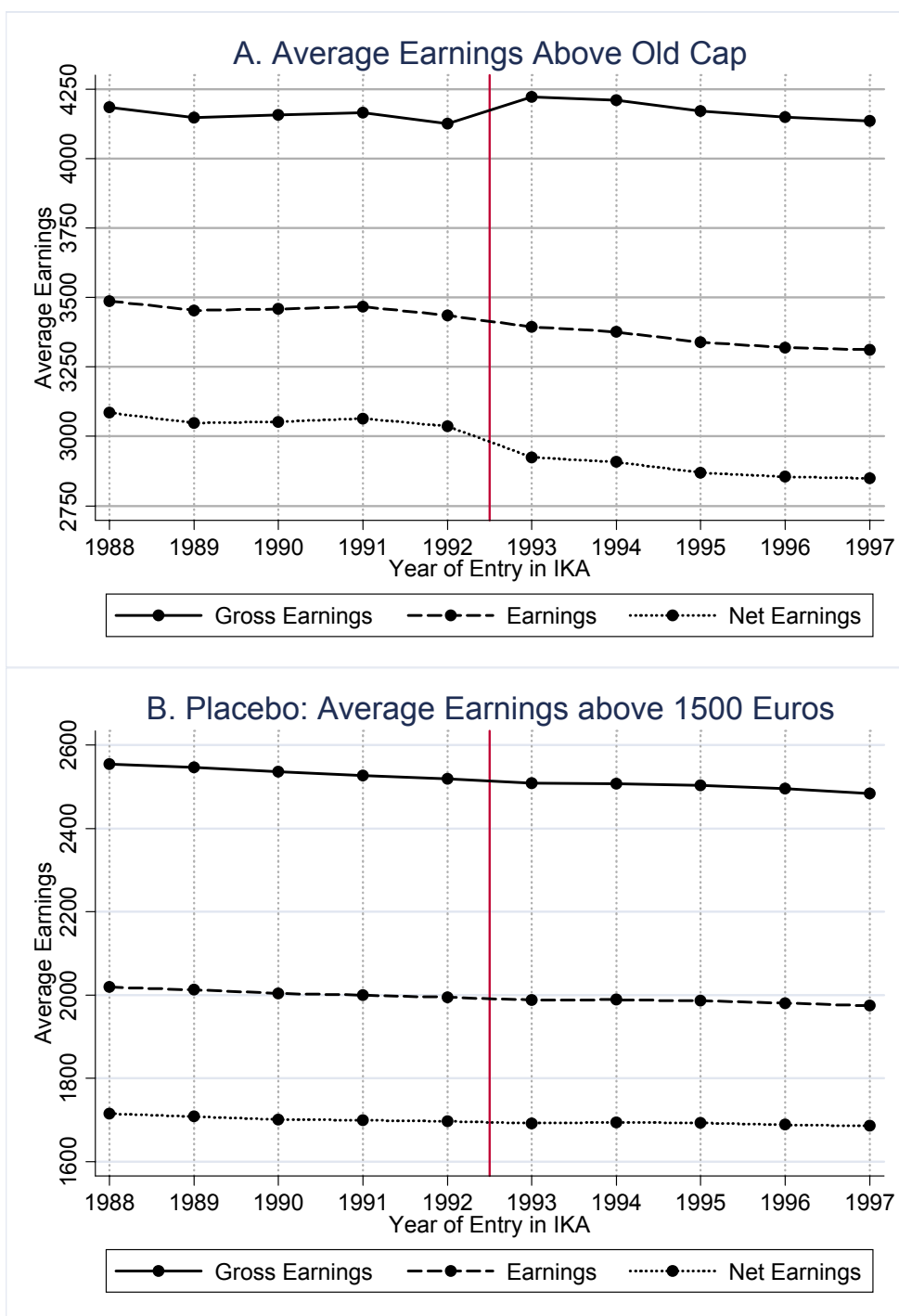


Figure 6. Effects on Gross Earnings, Earnings, and Net Earnings above Old Cap

Panel A displays, by year of entry in IKA, the average gross earnings, earnings, and net earnings, capped at the new cap, for all workers above the old cap as of March 2007. Formally, the three statistics are defined as $E(\min(z, z_N) | z > z_0)$, $E(\min(w, w_N) | w > w_0)$, $E(\min(c, c_N) | c > c_0)$. The graph shows that gross earnings jump up (relative to trend) at the cut-off date, earnings are continuous, and net earnings jump down, consistent with Figure 5. Panel B offers a placebo test by repeating the same series but average earnings capped at the old cap for all workers above 1500 Euros as of March 2007. In principle, such statistics should not be affected by the reform and indeed the graph confirms that there are no discontinuities at the cut-off dates.

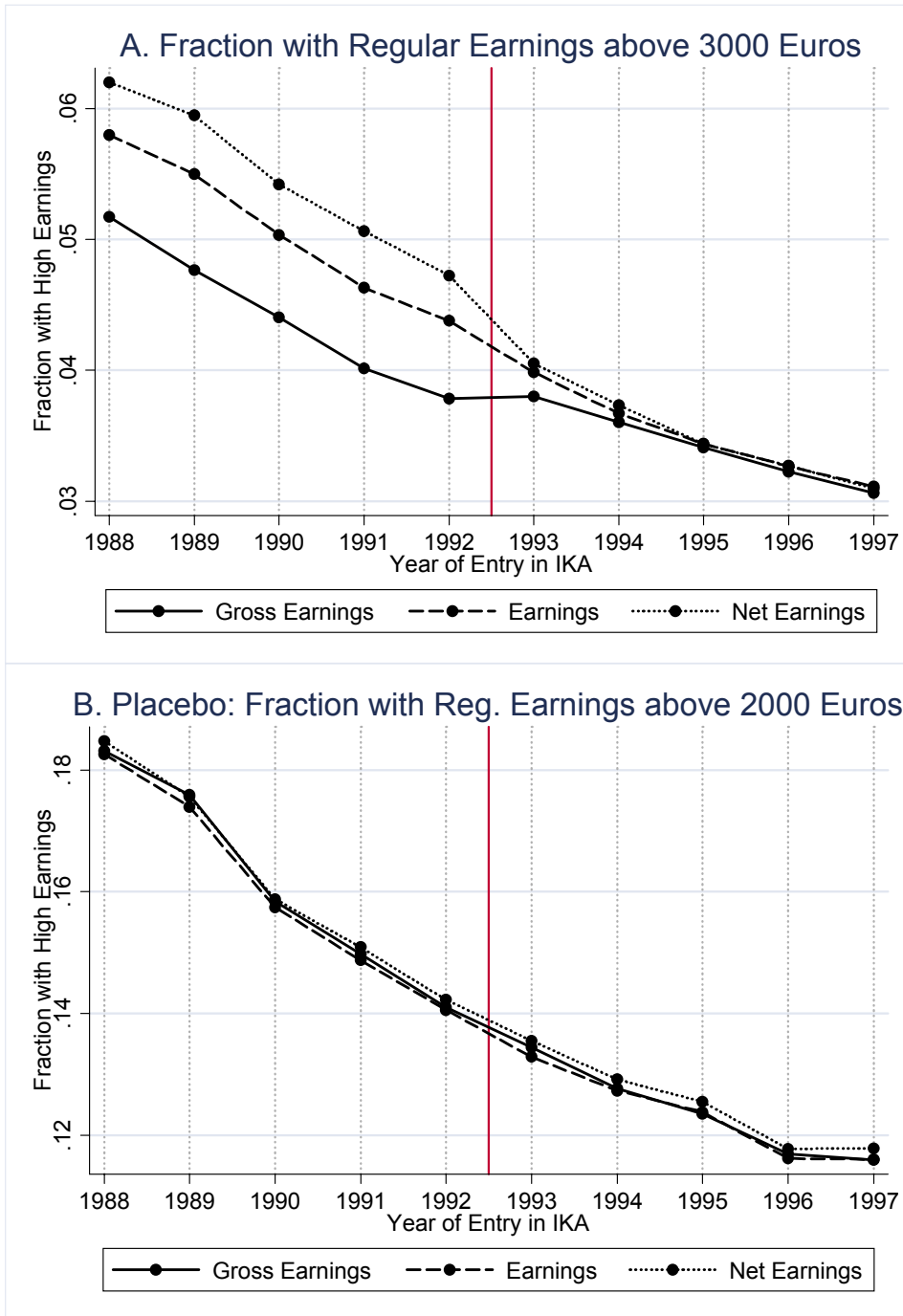


Figure 7: Fraction with Earnings above Threshold

Panel A displays, by year of entry in IKA, the fraction of workers with Regular gross earnings, earnings, and net earnings above $3000 \cdot (1+tR)$, 3000, and $3000 \cdot (1-tE)$ Euros as of March 2007. Regular earnings are defined as base salary (excluding overtime, bonuses, and other special payments). The graph shows an upward discontinuity for gross earnings, no discontinuity for earnings, and a downward discontinuity for net earnings, at the cut-off date, consistent with results in Figure 6. Panel B offers a placebo test by displaying the fraction of workers with Regular gross earnings, earnings, and net earnings above $2000 \cdot (1+tR)$, 2000, and $2000 \cdot (1-tE)$ Euros, which are below the old cap and should not be affected by the reform.

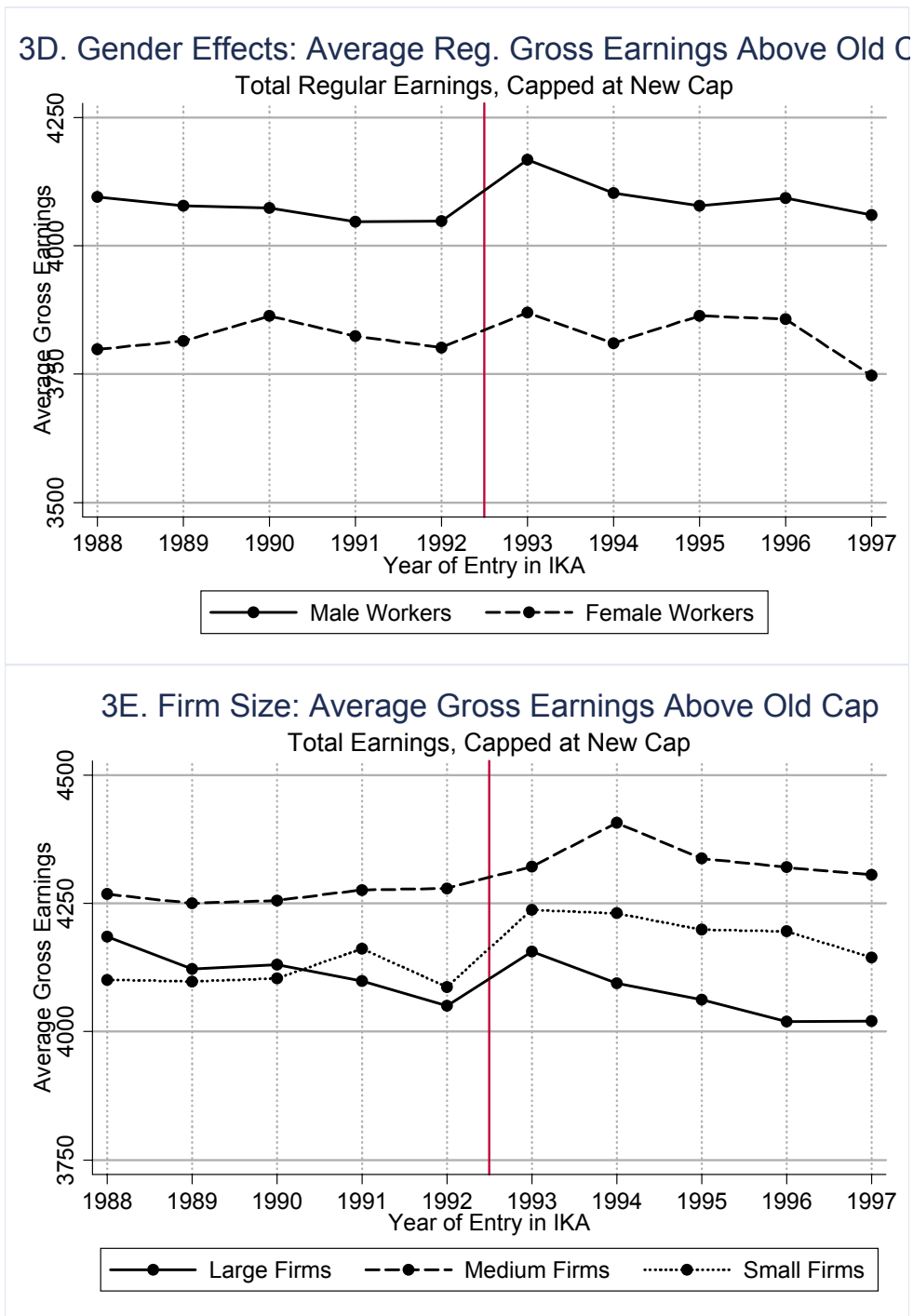


Figure 8. Second Stage: Heterogeneous Effects across Groups

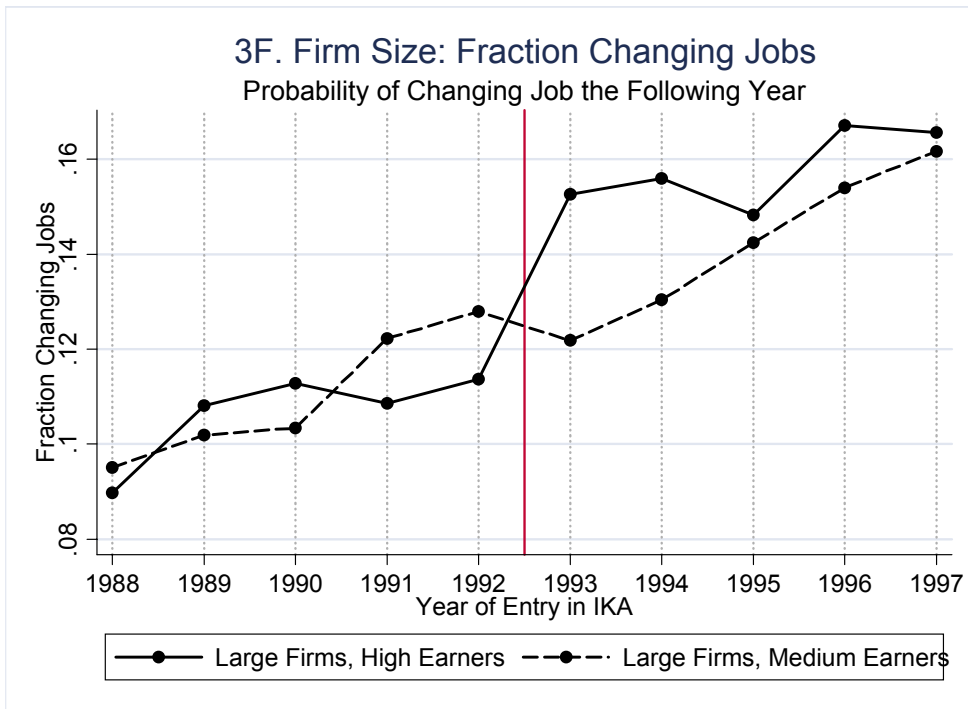


Figure 9. Second Stage: Fraction Changing Jobs

Table 1. IKA Payroll Tax System

A. Contribution Rates (most common case):

	Employer tax rate τ_R	Employee tax rate τ_E	Combined rate $\tau = (\tau_R + \tau_E) / (1 + \tau_R)$
Retirement benefits	16.33%	9.67%	
Sickness benefits	5.10%	2.55%	
Unemployment benefits	5.53%	2.43%	
Other benefits	1.10%	1.35%	
Total	28.06%	16.00%	34.41%

B. Monthly Earning Cap for Contributions (2007):

Old regime

(individuals with covered earnings before 1/1/1993)

€ 2,315.00

New Regime

(individuals with no covered earnings before 1/1/1993)

€ 5,279.57

Panel A displays contribution rates for employees covered by IKA in the most common case (coverage code 101). IKA contributions are assessed as a percentage of monthly earnings and shared between employees and employers. Those contributions fund retirement benefits, sickness benefits, unemployment benefits, and various other benefits. Contributions vary by coverage code corresponding to the occupation/sector of the employee. For example, contribution rates are higher in hazardous occupations. IKA covers a total of 2 million employees (45% of all active workers in Greece).

Panel B displays the earnings caps for IKA contributions. The cap applies on monthly earnings. The cap for employer contributions is based on the sum of monthly earnings paid to a given employee (including bonuses, overtime, etc.). The cap for employee contributions is based on the sum of monthly earnings from all covered jobs for the given employee (employees with multiple jobs who reach the cap and have overpaid contributions receive a refund from the government). The cap is 2,315 Euros for old regime workers defined as workers with positive covered earnings before 1/1/1993. The cap is 2.28 times higher at 5279.57 Euro for new regime workers defined as workers with no covered earnings before 1/1/1993. The caps have increased annual by 4% from 2004 to 2007. Under the old regime, the cap is pro-rated on the number of days worked. It is not pro-rated in the case of new regime workers.

Table 2. Summary Statistics (March 2007)

	1988-1992 entrants, any earnings	1993-1997 entrants, any earnings	1988-1992 entrants, Earnings>2315 Euros	1993-1997 entrants, Earnings>2315 Euros
	(1)	(2)	(3)	(4)
Percent New Regime	0.2% [4.1%]	95.3% [21.1%]	0.1% [3.8%]	90.5% [29.3%]
Percent Above Old Cap (2315 Euros)	10.4% [30.5%]	7.4% [26.1%]	100.0% [0%]	100.0% [0%]
Percent Above New Cap (5280 Euros)	1.5% [12.1%]	0.9% [9.5%]	14.4% [35.1%]	12.5% [33.0%]
Average Monthly Earnings	€ 1,427 [2021]	€ 1,262 [1731]	€ 4,185 [5396]	€ 3,991 [5508]
Average Monthly Regular Earnings	€ 1,233 [933]	€ 1,095 [689]	€ 2,879 [1929]	€ 2,575 [1394]
Percent with Overtime	11.3% [31.6%]	10.5% [30.7%]	19.2% [39.4%]	16.7% [37.3%]
Percent with Bonuses	9.4% [29.1%]	9.3% [29.1%]	36.9% [48.2%]	44.8% [49.7%]
Percent Male	54.2% [49.8%]	49.2% [50.0%]	68.6% [46.4%]	61.6% [48.6%]
Average Age	39.1 [5.6]	34.9 [5.9]	40.0 [4.7]	36.2 [4.9]
Number of jobs	1.036 [0.217]	1.048 [0.254]	1.043 [0.237]	1.056 [0.274]
Number of workers in firm	743 [1878]	794 [2035]	1655 [2491]	1744 [2575]
Percent changed jobs from March '06 to March '07	22.0% [41.4%]	25.8% [43.7%]	12.1% [32.6%]	14.3% [35.0%]
Marginal Tax Rates (MTR)				
Average employer MTR τ_R	24.7% [9.0%]	26.7% [5.0%]	0.6% [4.1%]	20.4% [11.0%]
Average employee MTR τ_E	14.3% [5.5%]	15.3% [3.4%]	0.1% [1.2%]	11.5% [6.4%]
Average total MTR $\tau=(\tau_R+\tau_E)/(1+\tau_R)$	30.5% [11.0%]	32.9% [6.0%]	0.6% [3.8%]	25.3% [13.5%]
Number of Observations:	208,374	225,758	21,648	16,624

The table displays summary statistics for 4 groups of individuals with Greek citizenship with positive IKA covered earnings as of March 2007. Column (1) is the set of individuals who entered IKA (i.e., started having covered IKA earnings) from 1988 to 1992 (old regime). Column (2) is the set of individuals who entered IKA (i.e., started having covered IKA earnings) from 1993 to 1997 (new regime). Column (3) includes 1988-1992 entrants with total monthly earnings above 2315 Euros in March 2007 (old regime cap). Column (4) includes 1993-1997 entrants with total monthly earnings above 2315 Euros in March 2007 (old regime cap).

The Table reports averages and standard deviation in parentheses. The percent new regime is not 100% for 1993-1997 entrants because individuals who can prove they had covered earnings in another insurance scheme before 1/1/1993 qualify for the old regime under IKA rules. Number of workers in firm is the average number of employees in the firm the individual has his main job (defined as highest regular earnings). A change of job from March '06 to March '07 is defined have a change in the main job (where regular earnings are highest) employer. Earnings are defined as earnings upon which payroll taxes are computed. Regular earnings include only base pay and exclude bonuses, overtimes, and other forms of earnings. The Marginal Tax Rates (MTR) are set equal to zero when the individual reaches the earnings caps corresponding to his/her regime.

Table 3. First Stage Results and Identification Checks

	1988-1997 entrants	1991-1994 entrants only	1988-1997 entrants	1988-1997 entrants	1988-1997 entrants
SAMPLE:	(1)	(2)	(3)	(4)	(5)
OUTCOMES:					
A. First Stage					
Percent in new Regime (%)	89.25 (0.09)	89.39 (0.20)	89.12 (0.10)	87.38 (0.14)	88.96 (0.20)
Percent with earnings above cap (%)	-5.87 (0.14)	-5.35 (0.23)	-5.89 (0.14)	-5.37 (0.21)	-5.24 (0.29)
Total MTR $\tau=(\tau_R+\tau_E)/(1+\tau_R)$ (%)	1.74 (0.05)	1.63 (0.09)	1.74 (0.05)	1.59 (0.08)	1.61 (0.11)
B. Identification Checks					
Number of monthly entrants	-690 (347)	-535 (530)	-529 (291)	22 (430)	-579 (595)
Number of monthly entrants with earnings above old cap					
Age (in years)	0.075 (0.035)	0.233 (0.060)	-0.024 (0.035)	-0.022 (0.053)	0.080 (0.072)
Gender (% male)	-3.14 (0.31)	0.09 (0.49)	-3.24 (0.31)	-0.03 (0.46)	0.33 (0.63)
Average Earnings (capped at old cap) (in Euros)	7.76 (3.35)	9.00 (5.38)	7.52 (3.41)	8.52 (5.06)	3.88 (6.97)
Included Controls					
Linear entry date trends	Yes	Yes	Yes	Yes	Yes
Monthly dummies			Yes	Yes	Yes
Quadratic date trends				Yes	Yes
Cubic entry date trends					Yes
Number of Observations:	434,132	166,895	434,132	434,132	434,132

The table displays the coefficients (with standard errors in parentheses) from regressing various outcomes (listed in the left-hand-side column) on a dummy for entering IKA on or after 1/1/1993 (which corresponds to new regime with higher earnings cap). The sample includes all entrants with positive monthly earnings in March 2007 (results are very similar in the other March 2004, March 2005, or March 2006 samples).

Column (1) estimates includes a linear entry date (normalized to 0 at 1/1/1993) and a linear entry date interacted with the dummy for entering IKA after 1/1/1993. Column (2) uses the same controls as column (1) but limits the sample to those entering IKA from 1991 to 1994. Column (3-5) use all 1988-1997 entrants but add successively Monthly dummies (col. 3), quadratic date trends (quadratic term and quadratic term interacted with the dummy for entering IKA after 1/1/1993), cubic date trends (cubic term and cubic term interacted with the dummy for entering IKA after 1/1/1993).

New regime is a dummy for being in the new regime (with the higher cap). Earnings above cap is a dummy for having earnings above the payroll tax earnings cap corresponding to the regime the individual is in. Total MTR is based on combined employee and employer payroll tax rates and set at zero when individual is above cap. In the case of the "number of entrants" outcome variable, we collapse the data by month of entry and run the regression at the monthly level (120 observations with 1988-1997 entrants, and 48 observations with 1991-1994 entrants). Average earnings (capped at old cap) is equal to $\min(\text{earnings}, 2315)$ where 2315 is the old cap earnings level (average earnings below the cap should not be affected by the regime change).

Table 4. Effects on Average Earnings above Old Cap

SAMPLE:	1988-1997	1991-1994	1988-1997	1988-1997	1988-1997
	entrants	entrants only	entrants	entrants	entrants
	(1)	(2)	(3)	(4)	(5)
OUTCOMES:					
A. Individuals with earnings above old cap and capping earnings at new cap					
Gross Earnings z	111 (14)	144 (23)	104 (14)	108 (21)	139 (29)
Earnings w	-29 (11)	2 (19)	-35 (12)	-25 (17)	0 (24)
Net Earnings c	-99 (10)	-74 (17)	-105 (11)	-97 (15)	-73 (21)
Number of Observations:	127,396	48,329	127,396	127,396	127,396
B. Individuals with regular earnings above old cap and capping earnings at new cap					
Regular Gross Earnings z	94 (17)	137 (27)	86 (17)	97 (26)	129 (35)
Regular Earnings w	-40 (14)	5 (23)	-47 (14)	-25 (21)	3 (30)
Regular Net Earnings c	-106 (13)	-61 (20)	-113 (13)	-87 (19)	-57 (26)
Number of Observations:	74,543	28,099	74,543	74,543	74,543
C. Placebo: Individuals with earnings above 1500 Euros and capping earnings at old cap					
Gross Earnings z	1.5 (2.6)	-5.2 (4.2)	0.8 (2.6)	-9.8 (3.9)	-4.1 (5.4)
Earnings w	2.1 (2.0)	-6.2 (3.3)	1.9 (2.1)	-8.3 (3.1)	-6.6 (4.3)
Net Earnings c	2.6 (1.9)	-7.8 (3.0)	2.7 (1.9)	-8.4 (2.8)	-9.0 (3.9)
Number of Observations:	357,348	136,985	357,348	357,348	357,348
Included Controls					
Linear entry date trends	Yes	Yes	Yes	Yes	Yes
Monthly dummies			Yes	Yes	Yes
Quadratic date trends				Yes	Yes
Cubic entry date trends					Yes

The table displays the coefficients (with standard errors in parentheses) from regressing various earnings outcomes (listed in the left-hand-side column) on a dummy for entering IKA on or after 1/1/1993 (which corresponds to new regime with higher earnings cap). The sample combines the 4 waves March 2004, March 2005, March 2006, March 2007. Earnings before 2007 are inflated by 4% per year so that caps coincide exactly across the 4 waves.

In panel A, the sample includes all entrants with monthly earnings above 2315 Euros (old cap). Earnings are capped at the new cap (5280 Euros) (i.e., earnings above 5280 Euros are replaced by 5280). Gross earnings are capped at $5280 \cdot (1+tR)$ (gross earnings new cap) and net earnings are capped at $5280 \cdot (1-tE)$ (net earnings new cap). In panel B, the sample includes all entrants with regular monthly earnings above 2315 Euros (old cap). Regular earnings (gross, earnings, and net) are also capped at the new caps ($5280 \cdot (1+tR)$, 5280, and $5280 \cdot (1-tE)$ Euros). In panel C, the sample includes all entrants with monthly earnings above 1500 Euros. Earnings are capped at the old cap (2315 Euros). Gross Earnings are capped at $2315 \cdot (1+tR)$ and net earnings are capped at $2315 \cdot (1-tE)$.

Table 5. Effects on Probability of High Earnings

	1988-1997 entrants			1991-1994 entrants only		
	Gross		Net	Gross		Net
	Earnings	Earnings	Earnings	Earnings	Earnings	Earnings
	(1)	(2)	(3)	(4)	(5)	(6)
OUTCOMES:						
A. Total Earnings:						
Percent with Earnings above 3000 Euros:	0.494 (0.056)	0.135 (0.058)	-0.134 (0.059)	0.301 (0.089)	-0.079 (0.092)	-0.353 (0.094)
Percent with Earnings above 5000 Euros:	0.148 (0.028)	-0.043 (0.031)	-0.208 (0.033)	0.178 (0.045)	0.019 (0.051)	-0.139 (0.053)
Percent with Earnings above 2000 Euros: (Placebo)	0.546 (0.093)	0.482 (0.092)	0.500 (0.090)	0.175 (0.149)	0.031 (0.147)	0.068 (0.145)
Number of Observations:	1,781,559	1,781,559	1,781,559	685,415	685,415	685,415
B. Regular Earnings:						
Percent with Earnings above 3000 Euros:	0.220 (0.041)	-0.004 (0.042)	-0.173 (0.043)	0.186 (0.065)	0.002 (0.067)	-0.153 (0.069)
Percent with Earnings above 5000 Euros:	0.035 (0.018)	-0.081 (0.021)	-0.173 (0.022)	0.079 (0.029)	-0.031 (0.033)	-0.111 (0.035)
Percent with Earnings above 2000 Euros: (Placebo)	0.167 (0.076)	0.148 (0.075)	0.141 (0.074)	0.072 (0.121)	-0.009 (0.120)	0.006 (0.117)
Number of Observations:	1,781,624	1,781,624	1,781,624	685,439	685,439	685,439

The table displays the coefficients (with standard errors in parentheses) from regressing various outcomes (listed in the left-hand-side column) on a dummy for entering IKA on or after 1/1/1993 (which corresponds to new regime with higher earnings cap). The sample combines the 4 waves March 2004, March 2005, March 2006, March 2007. Earnings before 2007 are inflated by 4% per year so that caps coincide exactly across the 4 waves. Columns (1) to (3) are based on all 1988-1997 entrants while columns (4) to (6) restrict the sample to 1991-1994 entrants. Outcomes are based on gross earnings in columns (1) and (4), on earnings in columns (2) and (5), and on net earnings in columns (3) and (6).

In panel A, the sample includes all individuals with positive earnings. In panel B, the sample includes all individual with positive regular earnings. All estimates are expressed in percent (i.e., each left-hand-side variable dummy is set equal to 0 or 100).

Table 6. Effects on Earnings: Heterogeneity across Groups

	1988-1997 entrants			1991-1994 entrants only		
	Gross		Net	Gross		Net
	Earnings	Earnings	Earnings	Earnings	Earnings	Earnings
	(1)	(2)	(3)	(4)	(5)	(6)
OUTCOMES: Average Earnings (below new cap) for individuals with earnings above old cap						
A. Gender Effects (regular earnings):						
Male Workers	130 (21)	-11 (17)	-81 (15)	177 (34)	37 (28)	-33 (25)
Number of Observations:	52776	52776	52776	19931	19931	19931
Female Workers	48 (27)	-77 (23)	-140 (21)	88 (44)	-36 (38)	-103 (34)
Number of Observations:	21767	21767	21767	8168	8168	8168
Difference between male and female workers	81 (36)	66 (31)	59 (27)	89 (59)	73 (50)	70 (44)
Number of Observations:	74,543	74,543	74,543	28,099	28,099	28,099
B. Firm's size (total earnings):						
Small firms (<400 workers)	117 (20)	-20 (16)	-90 (14)	122 (32)	-2 (27)	-66 (23)
Number of Observations:	65,531	65,531	65,531	24,944	24,944	24,944
Large firms (>400 workers)	114 (19)	-34 (23)	-108 (14)	169 (31)	6 (26)	-83 (23)
Number of Observations:	61,865	61,865	61,865	23,385	23,385	23,385
Difference between small and large firms	-4 (28)	-14 (23)	-18 (20)	48 (45)	7 (37)	-17 (33)
Number of Observations:	127,396	127,396	127,396	48,329	48,329	48,329

The table displays the coefficients (with standard errors in parentheses) from regressing earnings outcomes on a dummy for entering IKA on or after 1/1/1993 (which corresponds to new regime with higher earnings cap). The sample combines the 4 waves March 2004, March 2005, March 2006, March 2007. Earnings before 2007 are inflated by 4% per year so that caps coincide exactly across the 4 waves. Columns (1) to (3) are based on all 1988-1997 entrants while columns (4) to (6) restrict the sample to 1991-1994 entrants. Outcomes are based on gross earnings in columns (1) and (4), on earnings in columns (2) and (5), and on net earnings in columns (3) and (6). In all cases, the left-hand-side variable is earnings capped at the new cap, and the sample is always limited to workers with earnings above the old cap.

Panel A focuses on gender effects. In the first row of estimates, the sample is further limited to male workers. In the second row, the sample is limited to female workers. Finally, the third row presents the difference between male estimates and female estimates. The standard errors are obtained by regressing the left-hand-side on all RDD variables and all RDD variables interacted with a male dummy. Panel B focuses on firm's size effects. In the first row of estimates, the sample is limited to workers in small firms (defined as firms with less than 400 workers). In the second row, the sample is limited to workers in large firms (>400 workers). Finally, the third row presents the difference between small firms and large firms estimates.

Annex I

Questions in the Survey of Employers

- When you recruit a relatively young executive, do you know (or ask) which insurance regime s/he is under?
- Are you aware that social contributions for high earners first insured in 1993 or later are higher, due to the fact that their upper earnings ceiling is higher (e.g. €5,280 vs. €2,315 in 2007)?

If **yes**, do you take this factor into consideration when you take decisions with respect to hiring, paying, promoting or firing employees?

More specifically, does the different social insurance regime make it more likely for you to:

- avoid recruitment of high-earning “new insurees”?
- offer lower remuneration to high-earning new insurees (as their labour costs may be higher) compared to older workers with similar skills?
- grant high-earning new insurees lower pay rises (to recoup the extra cost in terms of social contributions) compared to older workers with similar skills?
- make new insurees redundant ahead of older workers with similar skills?

If **not**, why should a profit-maximising firm not take this factor into consideration?

[I let the interviewee respond spontaneously and then ask:]

Is it because the firm is concerned that discriminations on grounds of social insurance regime might:

- provoke new insurees to take legal action?
- harm morale in the firm?
- cause a reaction on the part of unions?